

What is claimed is:

1. An image collation apparatus/comprising:  
first collation means for obtaining a  
coincidence ratio between first and second images within  
a printing element range for each collation unit by  
collating the first and second images with each other;  
minimum coincidence ratio extraction means for  
obtaining a minimum coincidence ratio from coincidence  
ratios obtained from said first collation means; and  
determination means for determining that the  
first and second images are identical, if the extracted  
minimum coincidence ratio is smaller than a  
predetermined threshold.
2. An apparatus according to claim 1, wherein  
said apparatus further comprises first image  
transformation means for repeatedly executing at least  
one of translation processing and rotation processing  
for the first image within a predetermined range for  
each collation unit and outputting the first image after  
the image processing, and  
said first collation means obtains the  
coincidence ratio by collating the first image output  
from said first image transformation means with the  
second image every time said first image transformation  
means performs image processing.

3. An apparatus according to claim 1, wherein  
said apparatus further comprises  
maximum coincidence ratio extraction means for  
obtaining a maximum coincidence ratio from coincidence  
ratios output from said first collation means, and  
computation means for obtaining a difference  
between the maximum coincidence ratio output from said  
maximum coincidence ratio extraction means and the  
minimum coincidence ratio output from said minimum  
coincidence ratio extraction means, and  
said determination means comprises  
determination means for determining that the first and  
second images are identical, if the difference output  
from said computation means is not less than a  
predetermined threshold.

4. An apparatus according to claim 1, wherein  
said apparatus further comprises  
maximum coincidence ratio extraction means for  
obtaining a maximum coincidence ratio from coincidence  
ratios output from said first collation means, and  
computation means for obtaining a quotient by  
dividing the maximum coincidence ratio output from said  
maximum coincidence ratio extraction means by the  
minimum coincidence ratio output from said minimum  
coincidence ratio extraction means, and

11                   said determination means determines that the  
12 first and second images are identical, if the quotient  
13 output from said computation means is not less than a  
14 predetermined threshold.

5.               An apparatus according to claim 1, wherein  
2               said apparatus further comprises maximum  
3 coincidence ratio extraction means for obtaining a  
4 maximum coincidence ratio from coincidence ratios output  
5 from said first collation means, and  
6               said determination means determines that the  
7 first and second images are identical, if the maximum  
8 coincidence ratio output from said maximum coincidence  
9 ratio extraction means is not less than a first  
10 predetermined threshold and the minimum coincidence  
11 ratio output from said minimum coincidence ratio  
12 extraction means is smaller than a second predetermined  
13 threshold (first threshold  $\geq$  second threshold).

6.               An apparatus according to claim 2, wherein  
2               said apparatus further comprises  
3 second image transformation means for  
4 repeatedly executing at least one image processing of  
5 translation processing and rotation processing for the  
6 first image located at a first initial position by a  
7 predetermined amount within a predetermined range, and  
8 outputting the first image after image processing,

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9 second collation means for obtaining a  
10 coincidence ratio by collating the first image output  
11 from said second image transformation means with the  
12 second image every time said second image transformation  
13 means performs image processing, and  
14 storage means for storing a translation amount,  
15 rotational angle, or both a translation amount and  
16 rotational angle of the first image from the first  
17 information position to a current position when the  
18 coincidence ratio output from said second collation  
19 means becomes maximum, and  
20 said first image transformation means moves  
21 the first image to a second initial position set by  
22 adding the translation, rotational angle, or translation  
23 amount and rotational angle stored in said storage means  
24 to the first initial position, and executes at least one  
25 of translation processing and rotation processing for  
26 the first image.

7. An apparatus according to claim 6, wherein the  
2 range predetermined for said first image transformation  
3 means is narrower than the range predetermined for said  
4 second image transformation means.

8. An apparatus according to claim 6, wherein a  
2 collation region in which said second collation means  
3 obtains the coincidence ratio is smaller than a

4 collation region in which said first collation means  
5 obtains the coincidence ratio.

9. An apparatus according to claim 6, wherein  
2 the translation amount, rotational angle, or translation  
3 amount and rotational angle by which said second image  
4 transformation means moves the first image for each  
5 moving operation are larger than the translation amount,  
6 rotational angle, or translation amount and rotational  
7 angle by which said first image transformation means  
8 moves the first image for each moving operation.

10. An apparatus according to claim 2, wherein  
2 said apparatus further comprises  
3 reference point detection means for detecting  
4 reference points of the first and second images located  
5 at the first initial position, and  
6 correction amount computation means for  
7 obtaining a translation amount, rotational angle, or  
8 both translation amount and rotational angle of the  
9 first image which is required to make the reference  
10 points of the first and second image coincide with each  
11 other, and  
12 said first image transformation means moves  
13 the first image to a second initial position set by  
14 adding the translation amount, rotational angle, or  
15 translation amount and rotational angle obtained by said

16 correction amount computation means to the first initial  
17 position, and executes at least one of translation  
18 processing and rotation processing for the first image.

11. An apparatus according to claim 6, wherein  
2 said apparatus further comprises  
3 reference point detection means for detecting  
4 reference points of the first and second images located  
5 at the first initial position, and  
6 correction amount computation means for  
7 obtaining a translation amount, rotational angle, or  
8 both translation amount and rotational angle of the  
9 first image which is required to make the reference  
10 points of the first and second image coincide with each  
11 other, and  
12 said second image transformation means moves  
13 the first image to a new first initial position set by  
14 adding the translation amount, rotational angle, or  
15 translation amount and rotational angle obtained by said  
16 correction amount computation means to the first initial  
17 position, and executes at least one of translation  
18 processing and rotation processing for the first image.

12. An apparatus according to claim 1, wherein  
2 said apparatus further comprises region  
3 designation means for sequentially designating a  
4 plurality of collation regions predetermined as regions

5 in which the first and second images are collated with  
6 each other, and  
7 said first collation means obtains coincidence  
8 ratios by sequentially collating the first and second  
9 images with each other in the collation regions  
10 designated by said region designation means.

13. An apparatus according to claim 12, wherein  
2 said apparatus further comprises computation  
3 means for averaging minimum coincidence ratios  
4 corresponding to the respective collation regions output  
5 from said minimum coincidence ratio extraction means,  
6 and  
7 said determination means determines that the  
8 first and second images are identical, if the minimum  
9 coincidence ratio average output from said computation  
10 means is smaller than a predetermined threshold.

14. An apparatus according to claim 2, wherein  
2 said apparatus further comprises region  
3 designation means for sequentially designating a  
4 plurality of collation regions predetermined as regions  
5 in which the first and second images are collated with  
6 each other, and  
7 said first collation means sequentially  
8 obtains a coincidence ratio by collating the first image  
9 output from said image transformation means with the

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10 second image in each collation region designated by said  
11 region designation means every time said first image  
12 transformation means performs image processing.

15. An apparatus according to claim 14, wherein  
2 said apparatus further comprises computation  
3 means for averaging minimum coincidence ratios  
4 corresponding to the respective collation regions output  
5 from said minimum coincidence ratio extraction means,  
6 and  
7 said determination means determines that the  
8 first and second images are identical, if the minimum  
9 coincidence ratio average output from said computation  
10 means is smaller than a predetermined threshold.

16. An apparatus according to claim 14, wherein  
2 said apparatus further comprises selection  
3 means for comparing minimum coincidence ratios  
4 corresponding to the respective collation regions which  
5 are output from said minimum coincidence ratio  
6 extraction means and sequentially outputting only a  
7 predetermined number of minimum coincidence ratios in  
8 increasing order, and  
9 said computation means averages the minimum  
10 coincidence ratios output from said selection means.

17. An apparatus according to claim 1, wherein

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20. An apparatus according to claim 18, wherein  
2 said image processing means comprises  
3 thinning means for decreasing a line width of  
4 an input image to a value corresponding to about one

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16 angle of the first image from the first initial position  
17 to a current position when the coincidence ratio output  
18 from said second collation means becomes maximum, and  
19 said first image transformation means moves  
20 the first image to a second initial position set by  
21 adding the translation amount, rotational angle, or  
22 translation amount and rotational angle stored in said  
23 storage means to the first initial position, and  
24 executes at least one of translation processing and  
25 rotation processing for the resultant first image.

23.           An apparatus according to claim 22, wherein

2               said apparatus further comprises image

3 processing means for selecting one of contraction and

4 expansion for the second image and performing a

5 plurality of different image processes, and

6               said storage means for storing the second

7 image output from said image processing means, and

8               said second collation means obtains a

9 coincidence ratio by comparing/collating the first image

10 output from said second image transformation means with

11 the second image output from said storage means every

12 time said second image transformation means performs

13 processing.

24. An apparatus according to claim 22, wherein  
2 the range predetermined for said first image

3 transformation means is narrower than the range  
4 predetermined for said second image transformation means.

25. An apparatus according to claim 22, wherein  
2 the translation amount, rotational angle, or translation  
3 amount and rotational angle by which said second image  
4 transformation means moves the first image for each  
5 moving operation are larger than the translation amount,  
6 rotational angle, or translation amount and rotational  
7 angle by which said first image transformation means  
8 moves the first image for each moving operation.

26. An apparatus according to claim 22, wherein a  
2 collation region in which the coincidence ratio is  
3 obtained by said second collation means is smaller than  
4 a collation region in which a coincidence ratio is  
5 obtained by said first collation means.

27. An apparatus according to claim 3, wherein  
2 said apparatus further comprises region  
3 designation means for sequentially designating a  
4 plurality of collation regions predetermined as regions  
5 in which the first and second images are collated with  
6 each other, and  
7 said first collation means obtains coincidence  
8 ratios by sequentially collating the first image output  
9 from said image transformation means with the second

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15 designating a plurality of collation regions  
16 predetermined as regions in which the first and second  
17 images are collated with each other,  
18 wherein said first collation means obtains  
19 coincidence ratios by sequentially collating the first  
20 and second images within the collation regions  
21 designated by said region designation means.

30. An apparatus according to claim 29, wherein  
2 said apparatus further comprises image  
3 processing means for selecting one of contraction and  
4 expansion for one of the first and second images and  
5 performing a plurality of different image processes, and  
6 said first collation means collates an output  
7 from said image processing means with an image having  
8 undergone no image processing.

31. An image collation method comprising:  
2 the first collation step of obtaining a  
3 coincidence ratio in a predetermined range between first  
4 and second images in each collation unit by collating  
5 the first and second images with each other;  
6 the minimum coincidence ratio extraction step  
7 of obtaining a minimum coincidence ratio from  
8 coincidence ratios obtained in the first collation step;  
9 and  
10 the determination step of determining that the

11 first and second images are identical, if the extracted  
12 minimum coincidence ratio is smaller than a  
13 predetermined threshold.

32. A method according to claim 31, wherein

2 the method further comprises the first image  
3 transformation step of repeatedly executing at least one  
4 of translation processing and rotation processing for  
5 the first image within a predetermined range for each  
6 collation unit, and

7 in the first collation step, a coincidence  
8 ratio is obtained by collating the obtained first image  
9 after image processing with the second image.

33. A method according to claim 32, wherein

2 the method further comprises  
3 the maximum coincidence ratio extraction step  
4 of obtaining a maximum coincidence ratio from  
5 coincidence ratios output in the first collation step,  
6 and

7 the computation step of obtaining a difference  
8 between the maximum coincidence ratio and the minimum  
9 coincidence ratio, and

10 in the determination step, it is determined  
11 that the first and second images are identical, if the  
12 difference is not less than a predetermined threshold.

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34. A method according to claim 32, wherein  
2 the method further comprises  
3 the maximum coincidence ratio extraction step  
4 of obtaining a maximum coincidence ratio from  
5 coincidence ratios obtained in the first collation step,  
6 and  
7 the computation step of obtaining a quotient  
8 by dividing the maximum coincidence ratio by the minimum  
9 coincidence ratio, and  
10 in the determination step, it is determined  
11 that that the first and second images are identical, if  
12 the quotient is not less than a predetermined threshold.

35. A method according to claim 32, wherein  
2 the method further comprises the maximum  
3 coincidence ratio extraction step of obtaining a maximum  
4 coincidence ratio from coincidence ratios obtained in  
5 the first collation step, and  
6 in the determination step, it is determined  
7 that the first and second images are identical, if the  
8 maximum coincidence ratio is not less than a first  
9 predetermined threshold and the minimum coincidence  
10 ratio is smaller than a second predetermined threshold  
11 (first threshold  $\geq$  second threshold).

36. A method according to claim 32, wherein  
2 the method further comprises

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37. A method according to claim 36, wherein the range predetermined in the first image transformation step is narrower than the range predetermined in the second image transformation step.

38. A method according to claim 36, wherein a  
2 collation region in which the coincidence ratio is  
3 obtained in the second collation step is smaller than a  
4 collation region in which the coincidence ratio is  
5 obtained in the first collation step.

39. A method according to claim 36, wherein  
2 the translation amount, rotational angle, or translation  
3 amount and rotational angle by the first image is moved  
4 in the second image transformation step for each moving  
5 operation are larger than the translation amount,  
6 rotational angle, or translation amount and rotational  
7 angle by which the first image is moved in the first  
8 image transformation step for each moving operation.

40. A method according to claim 32, wherein  
2 the method further comprises  
3 the reference point detection step of  
4 detecting reference points of the first and second  
5 images located at the first initial position before the  
6 respective steps, and  
7 the correction amount computation step of  
8 obtaining a translation amount, rotational angle, or  
9 both translation amount and rotational angle of the  
10 first image which is required to make the reference  
11 points of the first and second image coincide with each

12 other, and  
13 the first image transformation step comprises  
14 the step of moving the first image to a second initial  
15 position set by adding the translation amount,  
16 rotational angle, or translation amount and rotational  
17 angle obtained in the correction amount computation step  
18 to the first initial position, and executing at least  
19 one of translation processing and rotation processing  
20 for the first image.

41. A method according to claim 36, wherein  
2 the method further comprises  
3 the reference point detection step of  
4 detecting reference points of the first and second  
5 images located at the first initial position before the  
6 respective steps, and  
7 the correction amount computation step of  
8 obtaining a translation amount, rotational angle, or  
9 both translation amount and rotational angle of the  
10 first image which is required to make the reference  
11 points of the first and second image coincide with each  
12 other, and  
13 the second image transformation step comprises  
14 the step of moving the first image to a new first  
15 initial position set by adding the translation amount,  
16 rotational angle, or translation amount and rotational  
17 angle obtained in the correction computation step to the

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18 first initial position, and executing at least one of  
19 translation processing and rotation processing for the  
20 first image.

42. A method according to claim 33, wherein  
2 the method further comprises the region  
3 designation step of sequentially designating a plurality  
4 of collation regions predetermined as regions in which  
5 the first and second images are collated with each other,  
6 and  
7 coincidence ratios are obtained by  
8 sequentially collating the first and second images with  
9 each other in the collation regions.

43. A method according to claim 42, wherein  
2 the method further comprises the image  
3 processing step of selecting one of contraction and  
4 expansion for one of the first and second images and  
5 performing a plurality of different image processes, and  
6 the first and second images are collated with  
7 each other by collating the image having undergone the  
8 image processing with an image having undergone no image  
9 processing.

44. An image collation method comprising:  
2 the first collation step of obtaining a  
3 relationship between first and second images for each

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4 collation unit by collating the first and second images  
 5 with each other;  
 6 the minimum coincidence ratio extraction step  
 7 of obtaining a minimum coincidence ratio from  
 8 coincidence ratios in the relationship obtained in the  
 9 first collation step;  
 10 the determination step of determining that the  
 11 first and second images are identical, if the extracted  
 12 coincidence ratio is smaller than a predetermined  
 13 threshold; and  
 14 the region designation step of sequentially  
 15 designating a plurality of collation regions  
 16 predetermined as regions in which the first and second  
 17 images are collated with each other,  
 18 wherein coincidence ratios are obtained by  
 19 sequentially collating the first and second images  
 20 within the collation regions.

45. A method according to claim 44, wherein  
 2 the method further comprises the image  
 3 processing step of selecting one of contraction and  
 4 expansion for one of the first and second images and  
 5 performing a plurality of different image processes, and  
 6 the first and second images are collated with  
 7 each other by collating the image having undergone the  
 8 image processing with an image having undergone no image  
 9 processing.

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46. A recording medium storing an image collation  
2 program for causing a computer to execute  
3 the first collation step of obtaining a  
4 coincidence ratio in a predetermined range between first  
5 and second images in each collation unit by collating  
6 the first and second images with each other,  
7 the minimum coincidence ratio extraction step  
8 of obtaining a minimum coincidence ratio from  
9 coincidence ratios obtained in the first collation step,  
10 and  
11 the determination step of determining that the  
12 first and second images are identical, if the extracted  
13 minimum coincidence ratio is smaller than a  
14 predetermined threshold.
47. A medium according to claim 46, wherein  
2 the program further comprises the first image  
3 transformation step of repeatedly executing at least one  
4 of translation processing and rotation processing for  
5 the first image within a predetermined range for each  
6 collation unit, and  
7 in the first collation step, a coincidence  
8 ratio is obtained by collating the obtained first image  
9 after image processing with the second image.
48. A medium according to claim 46, wherein

2 the program further comprises  
3 the maximum coincidence ratio extraction step  
4 of obtaining a maximum coincidence ratio from  
5 coincidence ratios output in the first collation step,  
6 and  
7 the computation step of obtaining a difference  
8 between the maximum coincidence ratio and the minimum  
9 coincidence ratio, and  
10 in the determination step, it is determined  
11 that the first and second images are identical, if the  
12 difference is not less than a predetermined threshold.

49. A medium according to claim 46, wherein  
2 the program further comprises  
3 the maximum coincidence ratio extraction step  
4 of obtaining a maximum coincidence ratio from  
5 coincidence ratios obtained in the first collation step,  
6 and  
7 the computation step of obtaining a quotient  
8 by dividing the maximum coincidence ratio by the minimum  
9 coincidence ratio, and  
10 in the determination step, it is determined  
11 that that the first and second images are identical, if  
12 the quotient is not less than a predetermined threshold.

50. A medium according to claim 46, wherein  
2 the program further comprises the maximum

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3 coincidence ratio extraction step of obtaining a maximum  
4 coincidence ratio from coincidence ratios obtained in  
5 the first collation step, and  
6 in the determination step, it is determined  
7 that the first and second images are identical, if the  
8 maximum coincidence ratio is not less than a first  
9 predetermined threshold and the minimum coincidence  
10 ratio is smaller than a second predetermined threshold  
11 (first threshold  $\geq$  second threshold).

51. A medium according to claim 46, wherein  
2 the program further comprises  
3 the second image transformation step of  
4 repeatedly executing at least one image processing of  
5 translation processing and rotation processing for the  
6 first image located at a first initial position by a  
7 predetermined amount within a predetermined range, and  
8 obtaining the first image after image processing,  
9 the second collation step of obtaining a  
10 coincidence ratio by collating the first image after the  
11 image processing with the second image every time image  
12 processing is performed for the first image, and  
13 the storage step of storing a translation  
14 amount, rotational angle, or both a translation amount  
15 and rotational angle of the first image from the first  
16 information position to a current position when the  
17 coincidence ratio becomes maximum, and

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18 in the first image transformation step, the  
19 first image is moved to a second initial position set by  
20 adding the translation, rotational angle, or translation  
21 amount and rotational angle stored in the storage step  
22 to the first initial position, and at least one of  
23 translation processing and rotation processing is  
24 executed for the first image.

52. A medium according to claim 51, wherein the  
2 range predetermined in the first image transformation  
3 step is narrower than the range predetermined in the  
4 second image transformation step.

53. A medium according to claim 51, wherein a  
2 collation region in which the coincidence ratio is  
3 obtained in the second collation step is smaller than a  
4 collation region in which the coincidence ratio is  
5 obtained in the first collation step.

54. A medium according to claim 51, wherein the  
2 translation amount, rotational angle, or translation  
3 amount and rotational angle by the first image is moved  
4 in the second image transformation step for each moving  
5 operation are larger than the translation amount,  
6 rotational angle, or translation amount and rotational  
7 angle by which the first image is moved in the first  
8 image transformation step for each moving operation.

55. A medium according to claim 46, wherein

2 the program further comprises

3 the reference point detection step of

4 detecting reference points of the first and second

5 images located at the first initial position before the

6 respective steps, and

7 the correction amount computation step of

8 obtaining a translation amount, rotational angle, or

9 both translation amount and rotational angle of the

10 first image which is required to make the reference

11 points of the first and second image coincide with each

12 other, and

13 the first image transformation step comprises

14 the step of moving the first image to a second initial

15 position set by adding the translation amount,

16 rotational angle, or translation amount and rotational

17 angle obtained in the correction amount computation step

18 to the first initial position, and executing at least

19 one of translation processing and rotation processing

20 for the first image.

56. A medium according to claim 46, wherein

2 the program further comprises

3 the reference point detection step of

4 detecting reference points of the first and second

5 images located at the first initial position before the

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6    respective steps, and  
7               the correction amount computation step of  
8    obtaining a translation amount, rotational angle, or  
9    both translation amount and rotational angle of the  
10   first image which is required to make the reference  
11   points of the first and second image coincide with each  
12   other, and  
13               the second image transformation step comprises  
14   the step of moving the first image to a new first  
15   initial position set by adding the translation amount,  
16   rotational angle, or translation amount and rotational  
17   angle obtained in the correction computation step to the  
18   first initial position, and executing at least one of  
19   translation processing and rotation processing for the  
20   first image.

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